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(54) Procedure and means for manufacturing storage battery plate assemblies.

(57) The present invention concerns a procedure and a means for manufacturing plate assemblies for a bipolar or semibipolar storage battery containing bipolar and monopolar plates which contain positive and/or negative active mass. The means (100) comprises forming apparatus disposed to form on an electrically insulating support material (27) a plate frame web (25) containing longitudinally continuous and transversally spaced plate frame blanks containing electrically conductive material, adding apparatus (35,36) disposed to add onto the plate frame web (25) containing plate frame blanks longitudinally continuous and transversally spaced zones constituted alternately by positive and negative active mass (20,21), and cutting apparatus disposed to cut by transversal and longitudinal cuts (A,B), from the plate frame web (25) containing active mass zones, plate assembly blanks containing bipolar and/or monopolar plates.

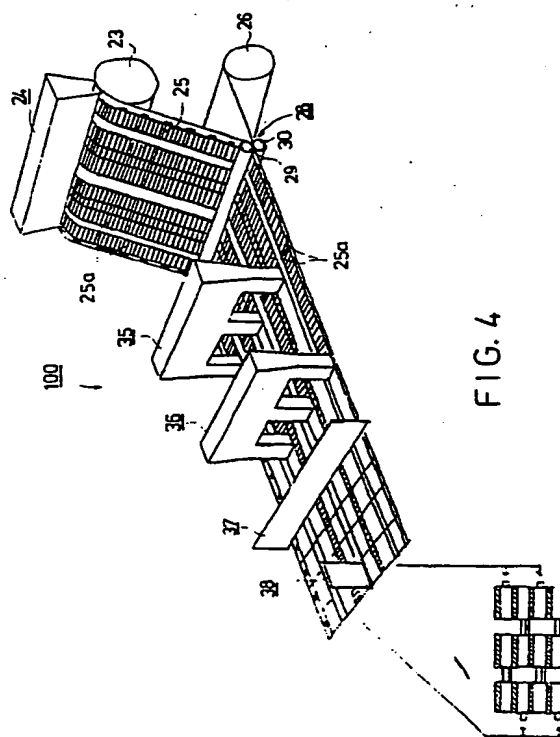


FIG. 4

Procedure and means for manufacturing storage battery plate assemblies

The present invention concerns a procedure for manufacturing plate assemblies for a bipolar or semibipolar storage battery comprising bipolar and monopolar plates which contain positive and/or negative active mass.

The invention also concerns a means for manufacturing plate assemblies for a bipolar or semibipolar storage battery containing bipolar and monopolar plates which contain positive and/or negative active mass.

The manufacturing of traditional lead storage batteries involve a great number of work steps, which are difficult to automate. Moreover, the work steps required in standard manufacturing methods impose certain strength requirements on the storage battery plate assemblies, and consequently one has to use for the storage battery plates unnecessarily great quantities of material in view of the operation of the storage battery; this adds to the weight of storage batteries and increases the manufacturing costs.

The aim of the invention is to achieve an improvement in procedures known in the art for manufacturing storage battery plates. The more detailed aim of the invention is to provide a procedure to enable the manufacturing of storage battery plates and assembly of the completed storage battery to be carried out in a continuous process and in a simple manner. The other aims of the invention and advantages to be gained therewith are readable in the disclosure of the invention.

The aims of the invention are achieved with the aid of a procedure which is mainly characterized in that:-

(a) on an electrically insulating support material is produced a plate frame web containing longitudinally continuous plate frame blanks containing electrically conductive material, spaced from each other;

(b) on the plate frame web containing plate frame blanks are added longitudinally continuous and transversally spaced zones which alternatively consist of positive and negative active mass;

(c) the plate frame web containing active mass zones is cut up with transversal cuts into plate assembly blanks containing bipolar and/or monopolar plates.

The aim of the invention is also to achieve an improvement in the apparatus of prior art for producing storage battery plate assemblies. The aims of the invention are achieved by the aid of a means which is mainly characterized in that the means comprises shaping means which have been disposed to produce on an electrically insulating support material a plate frame web containing longitudinally continuous plate frame blanks containing electrically conductive material and transversally spaced from each other; adding apparatus arranged to add onto the plate frame web containing plate frame blanks, longitudinally continuous and transversally spaced zones consisting alternatively of positive and negative active mass; and cutting apparatus disposed with transversal and longitudinal cuts to separate plate assembly blanks containing bipolar and/or monopolar plates, from the plate frame web containing active mass zones.

As taught by the invention, a procedure is obtained for manufacturing lead storage battery plate assemblies in a continuous process and for assembling storage batteries automatically. The procedure of the invention makes possible the manufacturing in series production by machine means, whereby little manual work is required.

As the invention teaches, a production and assembly line for lead storage battery plate assemblies is obtained in which the following principles are followed:

-The plate frames are manufactured in the form of a continuous strip consisting of support material, for instance of webbing, and of a plate frame cast thereon, or joined in another way thereto, and of active mass pasted upon the plate frame web likewise in the form of continuous strips. The continuous plate frame web is then cut up into separate plate frames, which are stacked together with separator plates to become completed storage battery plate assemblies.

-The plate frames thus produced are either monopolar plates for end cells or bipolar plates for intermediate cells. Both plate frame types are produced advantageously, though not necessarily, in one and the same work step.

-Between the plate frames stacked in final position in a storage battery case are formed partitions of a flowing, electrically insulating material impermeable to the electrolyte, which is cured in situ.

The novel manufacturing technique presented here offers remarkable advantages over the conventional production technique. Since the support material of the plate frames takes up the mechanical stresses occurring during production and service of the storage battery, the plate frames can be optimized with reference to their electrical properties. Since the plates are cast in the form of a continuous strip, the wiring interconnecting the plates may also be produced at the same time, and the number and shape of such leads can also be optimized in the way which is best in view of the operation of the storage battery.

Producing the cell partitions by means of injecting a hardening, electrically insulating material permeable to the electrolyte enables the assembly of the storage battery to be performed almost to completion in one automatically continuing work step.

Although the invention is in this context described as applied to a lead storage battery, it is obvious that the technique of the invention may also be applied in the case of such storage batteries in which another material is used in the storage battery plate material.

The invention is described in detail, referring to certain advantageous embodiments of the invention depicted in the figures of the drawings attached hereto, but to which the invention is not intended to be exclusively confined.

Fig. 1 presents in cross-sectional view a storage battery the plate assemblies of which have been produced in accordance with the invention.

Fig. 2 shows the section along the line II-II in Fig. 1.

Fig. 3a presents in top view an advantageous embodiment of the negative monopolar plate frame used in the storage battery of Fig. 1.

Fig. 3b presents in top view an advantageous embodiment of the bipolar plate frame used in the storage battery of Fig. 1.

Fig. 3c presents in top view an advantageous embodiment of the positive monopolar plate frame used in the storage battery of Fig. 1.

Fig. 4 shows an advantageous embodiment of the means of the invention for producing the storage battery plate assemblies, in schematic axonometric projection.

Fig. 5 presents an advantageous embodiment of the means of the invention for producing a plate frame web on a support material web, in schematic elevational view.

Fig. 6 presents in schematic elevational view another advantageous embodiment of the means of the invention for producing a plate frame web on a support material web.

Fig. 7 presents schematically in top view a plate frame web and a way in which the plate frame parts required for manufacturing a storage battery can be cut from the plate frame web.

Fig. 8 shows the stacking of completed plate frames, in schematic cross-section.

Fig. 9 presents schematically in top view a second plate frame web and the manner in which the required plate frame parts for producing a storage battery can be cut from said plate frame web.

Fig. 10 shows another mode of stacking completed plate frames cut from the plate frame web of Fig. 9, in schematic cross-section.

In the embodiment shown in Figs 1 and 2, a 6 V storage battery is in general indicated by reference numeral 10. The storage battery 10 comprises one or several cells enclosed in a case 11. Each cell contains electrolyte and monopolar plates 12 and bipolar plate 13 coated with positive and/or negative active mass and separated by separator plates 14. Furthermore, the storage battery 10 contains the requisite electrically conductive connectors which connect together plates 12, 13 and/or cells. The wall separating each cell from adjacent cells or from the case 11, or sealing it off, has been produced by filling the spaces surrounding the plate stacks located in the case 11 and the spaces therebetween with an electrically insulating substance 19 impermeable to the electrolyte, which has been cured directly in place to establish tightly sealed and/or insulating walls.

In Figs 1 and 2, lugs connecting plates with the same polarity are indicated with reference numerals 15a, respectively 15b. The positive terminal of the storage battery is indicated with reference numeral 16a and the negative terminal with reference numeral 16b. With reference numeral 18 is indicated an injection aperture through which an electrically insulating substance impermeable to the electrolyte is inserted in the case 11. With reference numeral 17 is indicated an acid supplying aperture, through which the storage battery 10 is filled with acid in a manner known in prior art, in order to obtain a storage battery ready for use.

As shown in Fig. 3a, the monopolar plate frame 12 is provided with negative active mass 21, respectively, in Fig. 3b the bipolar plate frame 13 is provided with positive active mass 20 and negative active mass 21, while the intervening portion 22 is uncoated, as is seen in Fig. 3c, the monopolar plate frame 12 is provided with positive active mass 20.

The electrically conductive bipolar plate, or bipolar plate grid, 13 is composed of a reticular structure containing electrically conductive material, one end 20 thereof being coated with positive and the other end 21 with negative active mass, and its intervening part 22 being uncoated. This kind of reticular structure consists of a support structure which does not conduct electricity, to which have been joined electrically conductive wires, or an electrically conductive reticular structure.

As in an advantageous embodiment of the invention, the storage battery of Fig. 1 consists of monopolar and bipolar plates 12, 13 stacked upon each other and of separator plates 14 so that in the outside cells every second plate is monopolar, 12, and every second plate is the end with opposite polarity of a bipolar plate 13. The intermediate cells contain ends with opposite polarity of bipolar plates 13 in alternation. At the points between cells and

uncoated portions 22 of the bipolar plate 13 are in register and constitute the electric leads passing through the insulating and/or sealing partition that has been formed on curing the electrically insulating and electrolyte-impermeable substance 19.

In the embodiment of Fig. 4 the means of the invention for manufacturing storage battery plate assemblies is in general indicated with reference numeral 100. The means 100 comprises, in the present embodiment, a continuous-action casting drum 23 to which molten lead is fed from a feeding funnel 24, a support net roll 26 for feeding a support net web 27 under the plate frame web 25 that has been cast, a hot-roll 28 for joining the cast plate frame web 25 to the support net web 27 by hot rolling, adding means 35 and 36 for adding negative, respectively positive, active mass on top of the plate frame/support net web 31, and cutting means 37 and 38 for cutting the plate frame parts required in manufacturing the storage battery. In Fig. 4 is schematically presented the stacking of monopolar and bipolar plates together with separator plate to make a blank for a 6 V storage battery.

In the embodiment of Fig. 5, to the continuous-action casting drum 23 molten lead is fed from the feeding funnel 24. When the casting drum 23 is rotating in the direction indicated by the arrow, a cast plate frame web 25 is produced. From the support net roll 26 the support net web 27 is fed in under the cast plate frame web 25 as indicated with an arrow. The support net web 27 and the plate frame web 25 deposited thereon pass through the hot-roll 28. The upper roll of the hot-roll 28 is indicated with reference numeral 29, and the lower roll with reference numeral 30. In Fig. 5, the completed support net/plate frame web is indicated with reference numeral 31. In the embodiment of Fig. 5 the plate frame web 25 produced by continuous casting is thus connected to the support net web 27 by means of hot-rolling.

In the embodiment of Fig. 6, the support net web 27 coming from the support net roll 26 in the direction indicated by an arrow is pressed against the casting drum 23 at a suitable temperature. With reference numeral 32 is indicated an auxiliary roll disposed to press the cast plate frame web 25 and the support net web 27 against the casting drum 23. With reference numeral 33 is indicated an auxiliary roll located lower down, after which the support net/plate frame web 31 travels in the direction indicated with an arrow. In this embodiment, the support net web 27 is above the plate frame web 25. When the procedure of Fig. 6 is applied, it is not necessary in the subsequent cutting phase to cut any metallic lead, in that the plate frames 25a may be cast in separate pieces.

As shown in Fig. 7, it is possible to manufacture by the procedure and means of the invention, modular plate assemblies for a lead storage battery for instance in the following manner. On a plastic or glass fibre net web 27 used for the support structure are cast plate frames 25a with a continuous-action casting machine. Since the support structure takes up any mechanical stresses, the plate frame 25a can be optimized with reference to their electrical properties. When the casting technique shown in Fig. 5 is employed, there may be a plurality of leads per each plate frame 25a from one cell to another. After the casting, the plastic/lead web 31 goes to a pasting process, in which the positive active masses 20 and the negative active masses 21 are pressed in place on the plate frames 25a. Thereafter, the web 31 is cut up into plate assemblies so that each plate assembly has at one end either a positive or a negative monopolar plate 12, and the requisite number of bipolar plates 13. In the embodiment of Fig. 7, the transversal cutting lines are indicated by letter A, and the longitudinal cutting line by letter B. The leads connecting the plate frames 25a are indicated with reference numeral 34.

As shown in Fig. 8, the monopolar plates 12 and bipolar plates 13 are stacked together with separator plates 14 to make the blanks of a storage battery 10a. This kind of blank contains at least two layers of plates so that one plate layer ends at one end in a negative and the other at the opposite end in a positive monopolar plate. When a storage battery contains several blanks, these are connected in parallel by casting lead jumpers to connect the lugs 15a and 15b of the blanks monopolar plates, or the lugs 15a and 15b are electrically connected to the respective lugs of the other blanks in another way. The blanks are packed in cases 11 for forming the separating partitions 19. Dry-out ripening, acid supply and forming are accomplished by a technique known in itself in the art, which is disclosed for instance in the earlier Finnish patent application No. 855096 by the same applicant. In the embodiment of Fig. 8 is presented an example of how a 12 V storage battery 10a is manufactured.

As depicted in Figs 9 and 10, in an advantageous embodiment of the invention the steps in manufacturing a blank for a 12 V storage battery 10b are as follows. First, the starting point is a support net web 27 of width twice the length of a completed storage battery 10b. Upon this support net web 27 are attached the plate frames 25a, for instance applying the casting technique of Fig. 5. Next, the plate frames 25a are pasted in the following step as shown in Fig. 4. The pasting may be carried out with a pasting machine 35,36 which produces band-like stripes of active mass on the

appropriate areas of the plate frames 25a. The areas 22 between the active mass strips 20 and 21 remain free of mass. On these areas 22 is later injected insulating material 18 to form the cell partitions. The bipolar plates 13 are formed by these pairs of strips, where the plate frames 25a with positive and negative active mass 20, 21 are fused together. The monopolar plates 12 are outermost on the sides. On the monopolar plates 12 are cast lugs 15a and 15b by which they are, subsequent to stacking the storage battery 10b, connected to the terminal posts 16a and 16b. The web 31 is cut up into plate assemblies in the manner shown by the cutting lines A and B, and the plate assemblies are stacked together with separator plate 14 to become blanks for a storage battery 10b, as depicted in Fig. 10. The separator plates may also be connected to the active mass strips 20,21 prior to cutting, which considerably simplifies the stacking. The cutting of the web 31 along the lines A and B may be accomplished e.g. by means of a high velocity water jet. In Fig. 10 is presented a manufacturing example of a 12 V semibipolar storage battery.

Claims

1. A procedure for manufacturing plate assemblies for a bipolar or semibipolar storage battery comprising bipolar and monopolar plates containing positive and/or negative active mass, characterized in that:-

(a) on an electrically insulating support material (27) is formed a plate frame web (25) containing longitudinally continuous and transversally spaced plate frame blanks containing electrically conductive material;

(b) on the plate frame web (25) containing plate frame blanks are added zones constituted by alternatingly positive and negative active mass which are continuous in the longitudinal direction and transversally spaced;

(c) plate blanks containing bipolar and/or monopolar plate are cut with transversal and longitudinal cuts from the plate frame web (25) containing active mass zones.

2. Procedure according to claim 1, characterized in that the electrically conductive plate frame web (25) is produced by casting a lead blank to constitute the plate frames (25a) and wirings connecting same.

3. Procedure according to claim 2, characterized in that a support net web (27) of a plastic material is formed and the cast plate frame web (25) is joined to the support net web (27) by means of hot-rolling.

4. Procedure according to claim 2, characterized in that a support net web (27) of a plastic material is formed and the cast plate frame web (25) is connected to the support net web (27) by pressing the support net web (27) against a casting drum (23) and the plate frame web (25) which the latter produces.

5. Procedure according to any one of the preceding claims, characterized in that the plate frame web (25) containing active mass zones and a web containing separator mass are conducted in superimposed contact to the cutting phase for the purpose of cutting the storage battery plates and the separator plate in one work phase.

6. A means for manufacturing plate assemblies for a bipolar or semibipolar storage battery containing bipolar and monopolar plates which contain positive and/or negative active mass, characterized in that the means (100) comprises forming apparatus arranged to form on an electrically insulating support material (27) a plate frame web (25) containing longitudinally continuous and transversally spaced plate frame blanks containing electrically conductive material; adding apparatus (35,36) disposed to add onto the plate frame web (25) containing plate frame blanks longitudinally continuous and transversally spaced zones constituted by alternatingly positive and negative active mass (20,21); and cutting apparatus (37,38) disposed by transversal and longitudinal cuts (A,B) to cut, from the plate frame web (25) containing active mass zones, plate assembly blanks containing bipolar and/or monopolar plates.

7. Means according to claim 6, characterized in that said forming apparatus comprises a continuous-action casting drum (23), a feeding funnel (23) for feeding molten lead to said continuous-action casting drum (23), a support net roll (26) for feeding a support net web (27) in under the plate frame web (25), and a hot-roll (28) for joining the cast plate frame web (25) to the support net web (27) by hot-rolling.

8. Means according to claim 6, characterized in that said forming apparatus comprises a continuous-action casting drum (23), a feeding funnel (24) for feeding molten lead to said continuous-action casting drum (23), a support net roll (26) for feeding the support net web (27) upon the cast plate frame web (25), and a compression means (32) for pressing the support net web (27) coming from the support net roll (26) against the casting drum (23) and the plate frame web (25) thereby produced.

9. Means according to any one of claims 6-8, characterized in that said adding apparatus (35,36) is arranged to press the strip-like positive active masses (20) and the strip-like negative active masses (21) in place upon the plate frames (25a).

10. Means according to any one of claims 6-9, characterized in that the cutting means (37,38) comprise high velocity water jets.

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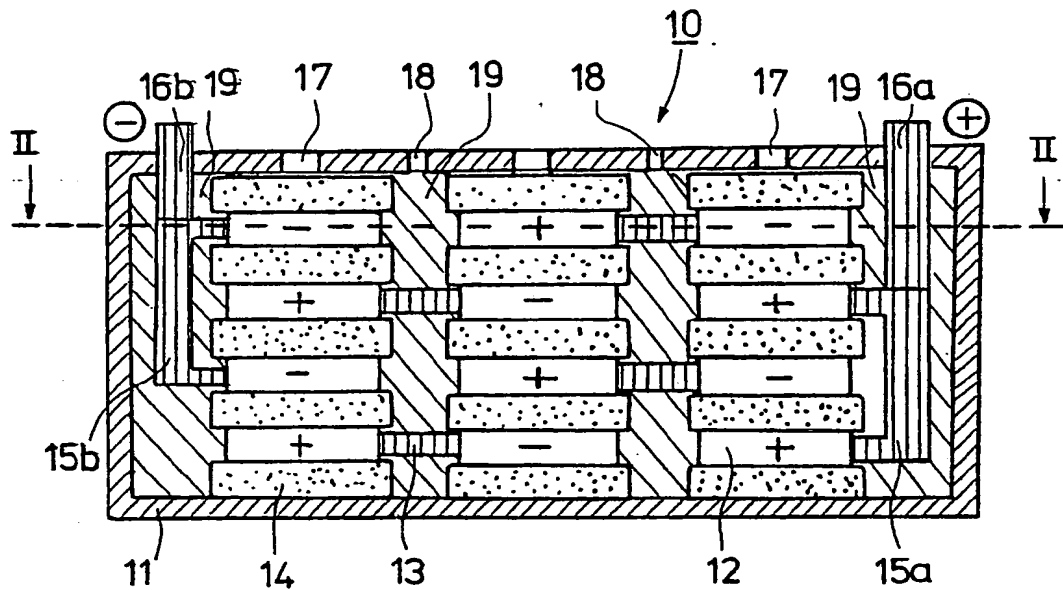


FIG. 1

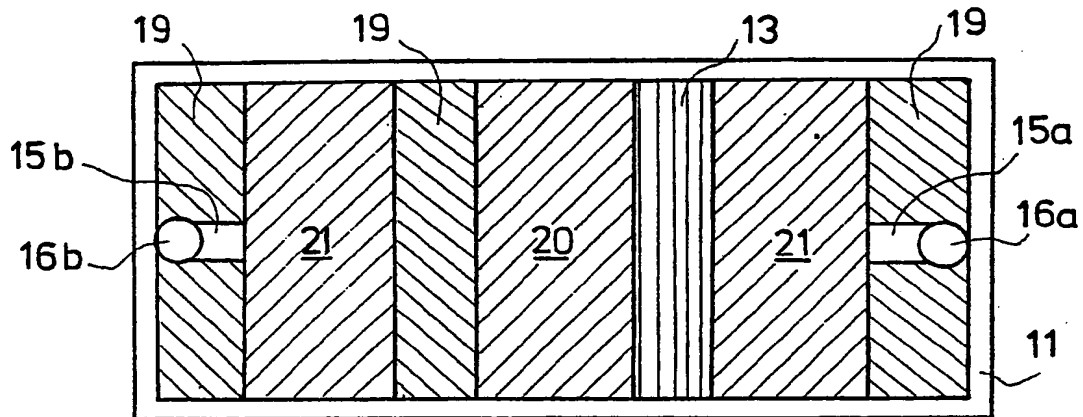


FIG. 2

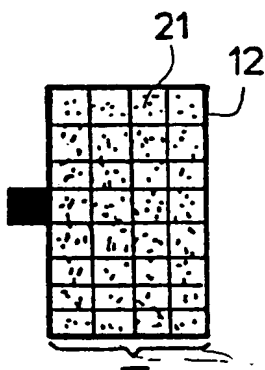


FIG. 3a

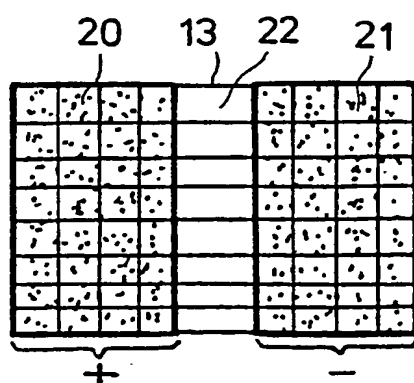


FIG. 3b

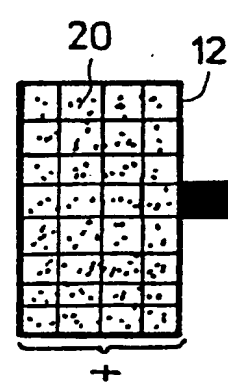


FIG. 3c

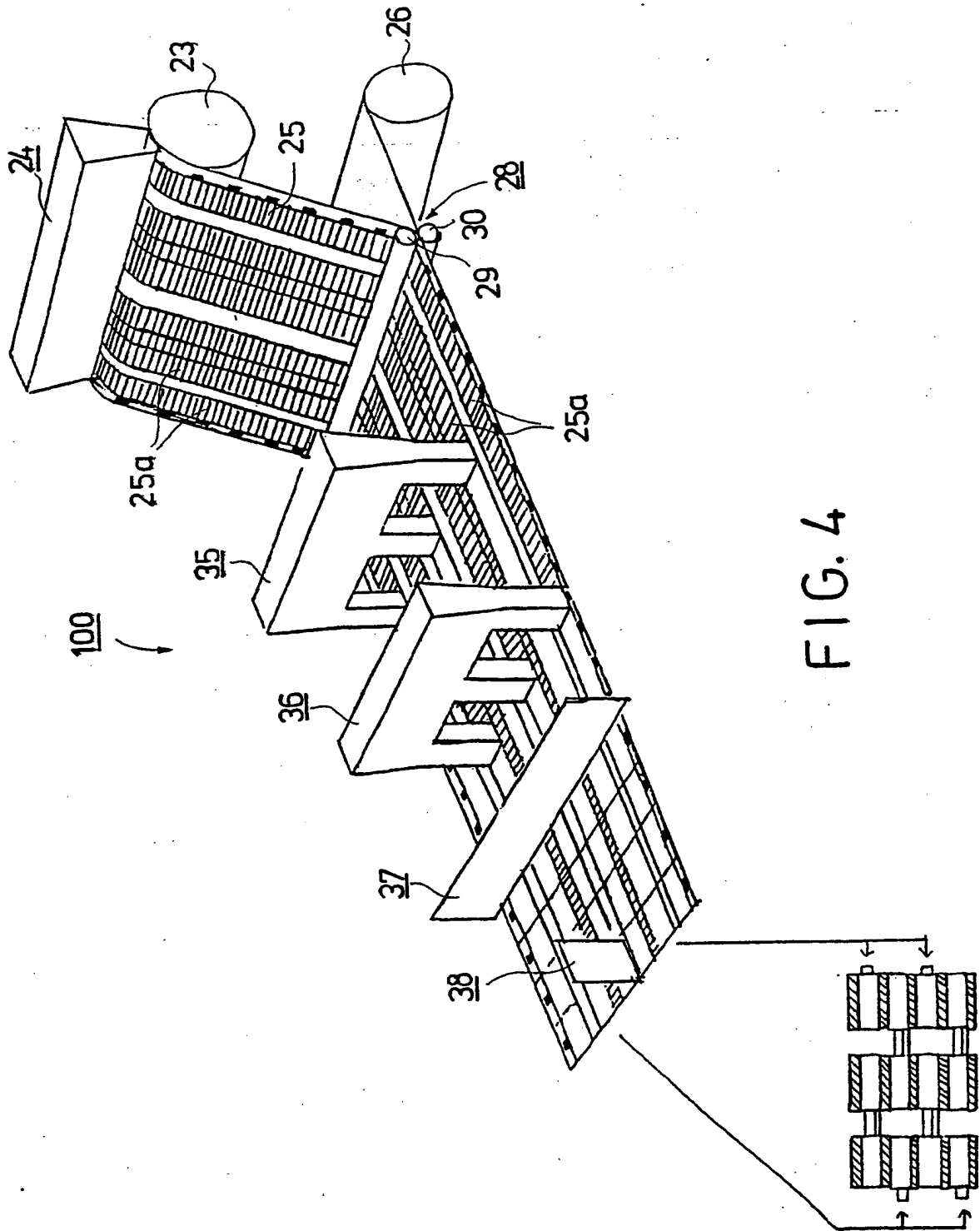


FIG. 4

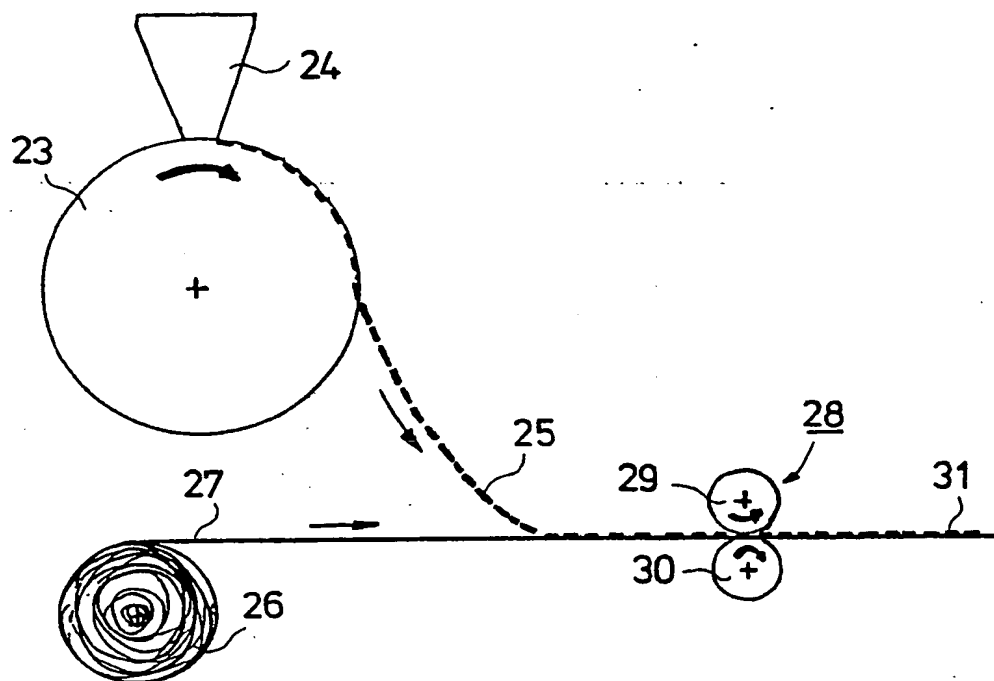


FIG. 5

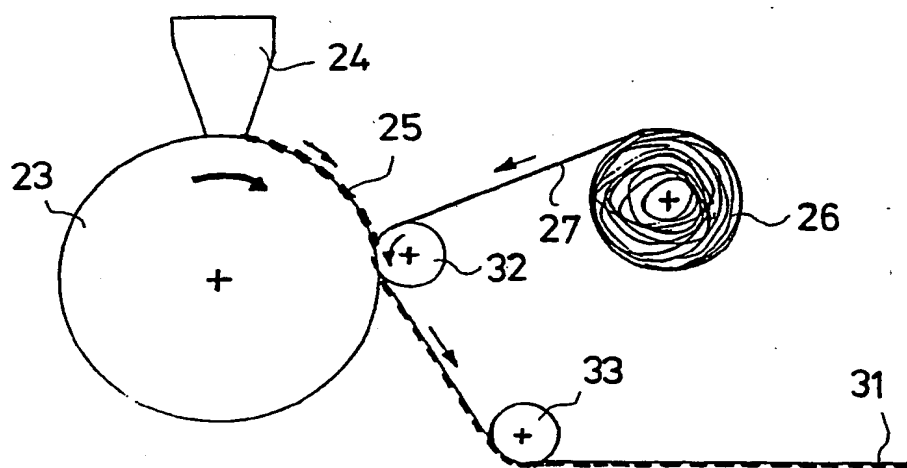
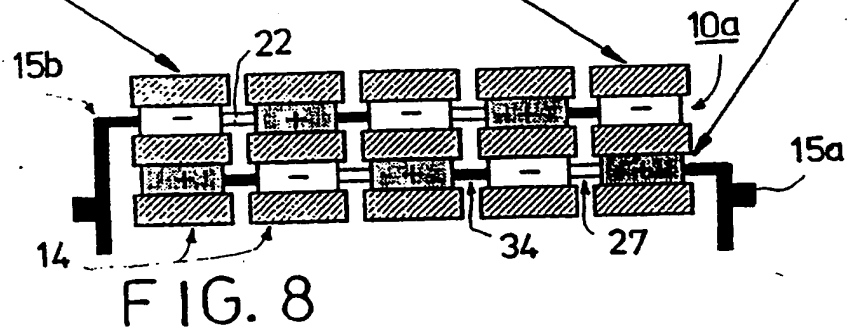
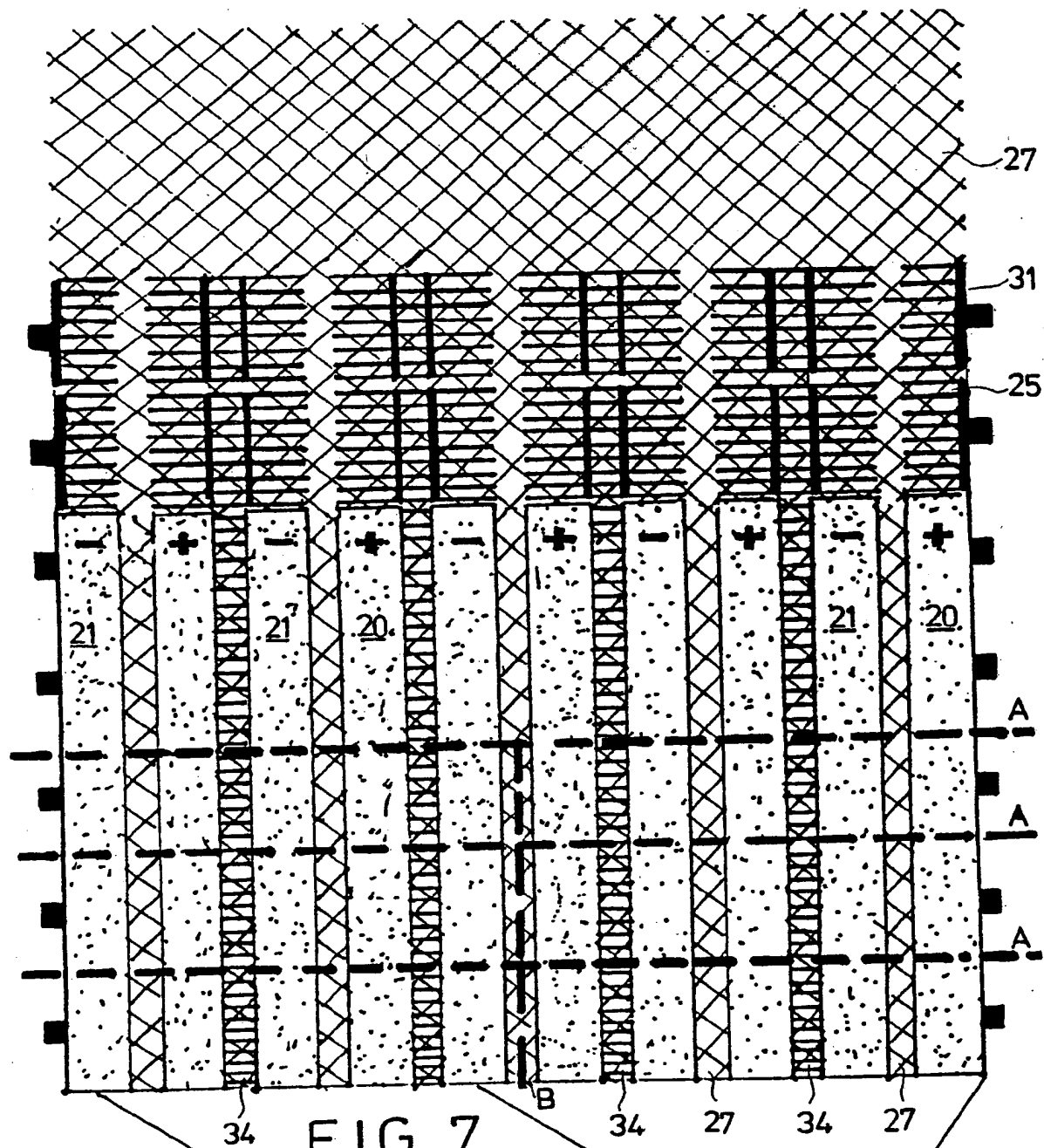


FIG. 6



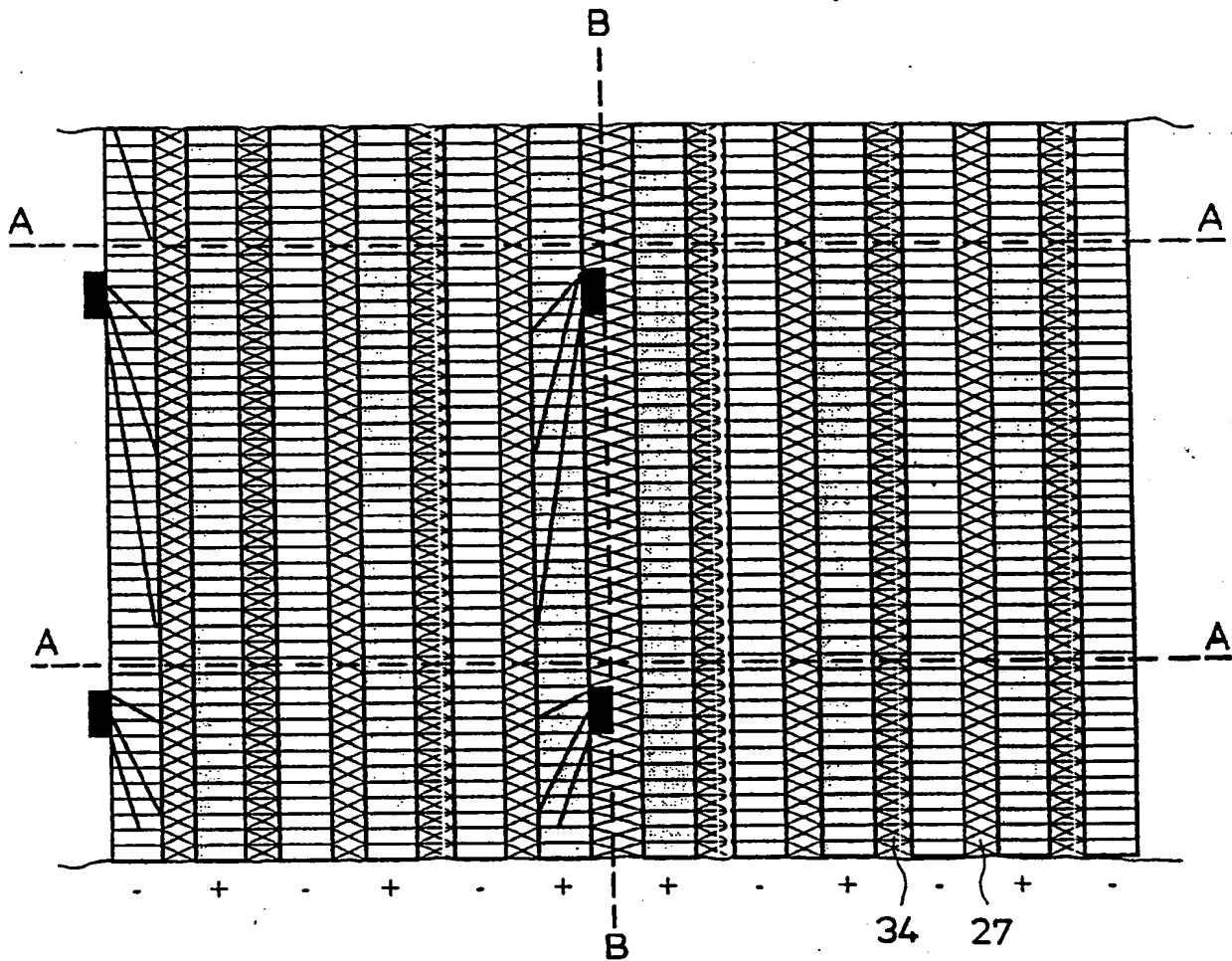


FIG. 9

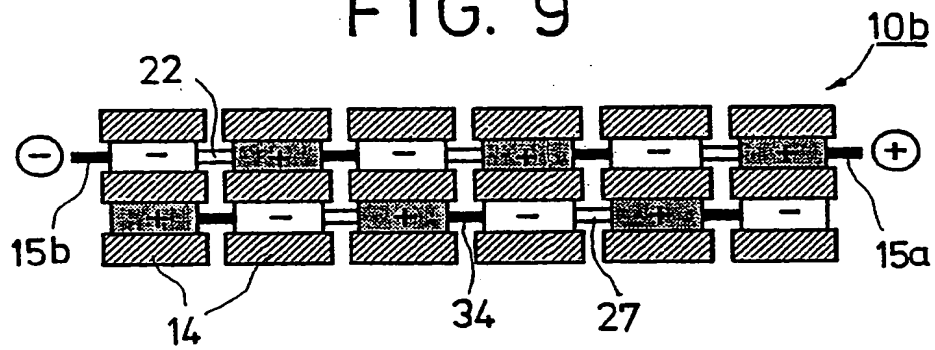


FIG. 10



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	PATENT ABSTRACTS OF JAPAN, vol. 7, no. 62 (E-164)[1207], 15th March 1983; & JP-A-57 208 071 (NIHON DENCHI K.K.) 21-12-1982 * Whole abstract *	1,2,4-8	H 01 M 10/18 H 01 M 4/73
Y	EP-A-0 107 976 (CHLORIDE GROUP PLC) * Abstract; page 12, line 15 - page 14, line 20; figures 4,5; page 23, lines 2-19 *	1,2,4-8	
A	US-A-4 192 049 (PARKINSON et al.) * Figures 1,6,6a; column 5, lines 38-64; column 6, lines 1-3 *	1	
A	FR-A-1 092 426 (COMPAGNIE GENERALE D'ELECTRICITE) * Figures 1,2; claims 1,5 *	1	TECHNICAL FIELDS SEARCHED (Int. Cl.4) H 01 M
A	DE-A-3 124 703 (BOSCH GmbH)		
A	PATENT ABSTRACTS OF JAPAN, vol. 6, no. 189 (E-133)[1067], 28th September 1982; & JP-A-57 101 348 (SHINKOUBE DENKI K.K.) 23-06-1982		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 23-06-1987	Examiner COOK S.D.
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			